NSSG DELIVERED BY Cogent Skills

NUCLEAR TOGETHER

A scenario-based approach to nuclear workforce planning

www.nssguk.com

Summary of Nuclear Workforce Data 2023

As part of the Nuclear Skills Strategy Group's (NSSG) support of skills development within the nuclear industry, it collates and models data to assess current and projected workforce requirements. Over the past eight years, data have been synthesized into a series of reports. Since the last publication in 2021, we have undertaken several enhancements, including refining forecasts, broadening the scope of data collection, and making analysis agile. A controlled access web interface has been developed to facilitate analysis tailored to specific workforce inquiries.

Forecasts and analyses from the model have already been used to support proposed interventions, notably through the recently constituted Nuclear Skills Task Force. The purpose of this report however, is to distil the most current top-level UK nuclear workforce statistics, rather than draw detailed strategic inferences. More granular analyses of specific areas will be provided periodically and in response to specific inquiries. Nevertheless it is important to view the data in the light of ongoing operations and current expectations.

UK nuclear context

The UK nuclear workforce includes ongoing decommissioning, the generation of electrical power, and the support of the Defence nuclear enterprise (DNE). As the ageing operational Civil reactor fleet transitions into the decommissioning phase, plans continue for the development of up to 24 gigawatts of new power generation. This is an important part of the government's strategy to improve energy security and achieve net-zero greenhouse gas emission by 2050. A range of technical options exists, from Small Modular Reactors to gigawatt scale plant of the type currently under construction at Hinkley Point C, and planned at Sizewell C.

Final decisions have yet to be made on the mix of technologies and the construction sequencing. Consequently, a scenario-based approach is essential for sector-level workforce forecasting.

Large Scale New Build

The majority of the existing fleet of nuclear power stations will retire by the end of this decade. Only Sizewell B will remain in operation. Hinkley Point C is expected to be comissioned in the mid-2030s.

Last year the government confirmed its support for Sizewell C and is currently looking for investors.

The government's 24 GW target by 2050 may be met by new large-scale plants, or advanced nuclear technologies like Small Modular Reactors (SMRs) or Advanced Modular Reactors (AMRs), but the mix is uncertain.

Extensions

EDF plans to extend the operational lives of two nuclear power stations—Heysham 1 and Hartlepool—until early 2026.

Small Modular Reactors and Advanced Modular Reactors

The funding package announced with the launch of Great British Nuclear (GBN) included a commitment of up to £77.1M to accelerate advanced nuclear business development in the UK.

GBN has been tasked with choosing between alternative SMR propositions.

- 6 companies in the GBN SMR competition including 3 that are current members of the NSSG/NSAN - Rolls-Royce SMR, EDF and Westinghouse.

- Newcleo SMR (also an NSAN member) – using waste as a fuel, and proceeding to a pilot plant in France before moving into the UK.
- Ultra Safe Nuclear Corporation (USNC) – Micro Modular Reactor Development with Jacobs.
- The National Nuclear Laboratory Nuclear Fuel – high temp reactor developments in conjunction with Japan.

Nuclear Fuel

GBN's Nuclear Fuel Fund is enabling eight projects to develop new fuel production and manufacturing capabilities in the UK. Current policy is that all fuel will be manufactured in the UK.

Fusion R&D

The government announced plans for a new suite of R&D programmes to support the UK's fusion sector and strengthen international collaboration and support the UK Fusion Strategy. The first site has been chosen as Burtonwood in the Midlands, and a £600m fund has been announced to support over 2,000 people in training and development. The Fusion workforce is not currently covered by the Nuclear Workforce Model and is not included in the figures here.

Defence

The UK is engaged in two submarine build programmes: the Astute Class and the Dreadnought Class.

Additionally, the AUKUS (Australia, UK, and USA) partnership will deliver a trilaterally developed attack submarine, known as SSN-AUKUS. This collaboration underscores the importance of shared expertise and resources on a global scale.

Decommissioning

The Nuclear Decommissioning Authority is working to overcome the challenges of nuclear clean-up and decommissioning, with the aim to prepare 17 nuclear sites for their next use by 2033. The defueled EDF fleet will transition over to Magnox in around 2025, beginning with Hunterston. Although decreasing its workforce demand, decommissioning is a substantial activity and replacement demand still generates an important requirement for nuclear skills, and will for the foreseeable future.

Waste Management

Waste management considerations are also essential to understand and treat legacy wastes and to ensure that new plants are designed and developed with the end-state products in mind. Nuclear Waste Services' development of a Geological Disposal Facility (GDF) is progressing. In addition, there are significant developments underway to improve the existing Low Level Waste Repository in Seascale.

The Scenarios

Currently, three Civil generation targets for 2050 are being considered by the NSSG; 7.6 gigawatts, 16 gigawatts, and 24 gigawatts. All assume the life-extension of Sizewell B to beyond 2050.

The recent agreement between the Australian, UK and United States governments (AUKUS) to collaborate on nuclear submarine construction has made a significant impact on the Defence nuclear workforce requirements. Here too, three options are analysed; continued UK operations in the absence of AUKUS, a lower level AUKUS activity (AUKUS S1) and a higher level AUKUS activity (AUKUS S2).

The combination of the three scenarios, for each of Civil and Defence, create 9 possibilities. Three scenarios have been chosen to represent this range, namely:

1. 7.6 gigawatts and continuation of the pre-AUKUS Defence programme
2. 16 gigawatts and AUKUS S1
3. 24 gigawatts and AUKUS S2

Over the period from 2023 to 2043 the current nuclear workforce of 83,000 is forecast to rise to 123,000 in scenario one, 152,000 in scenario two, and 180,000 in scenario three.

As in previous reports, The demand picture is constructed from forecasts from the major Civil nuclear operators and developers, the Ministry of Defence and its industrial partners, and a modelled component for the scenario based Civil new build programme.

Detailed information on the workforce requirements for new technologies, most notably small modular reactors, is still scarce. Until a more refined view is available, the model supporting the data in this report continues to use an SMR workforce profile previously described, and based on NIRO estimates.

Forecasts for three Scenarios

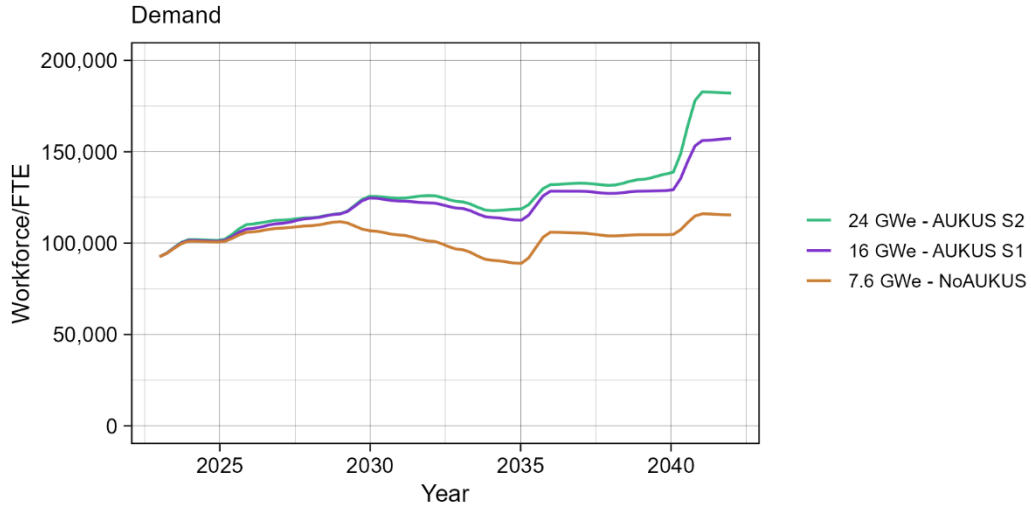

Figure 1

Figure 1 shows three calculated scenario combinations for Civil and Defence over the period from 2023 to 2043. In the long-term the programme demand is most significantly affected by the Defence scenario that is included. While important in its detailed impact, a Civil generation newbuild programme has comparatively little impact on the top line figure.

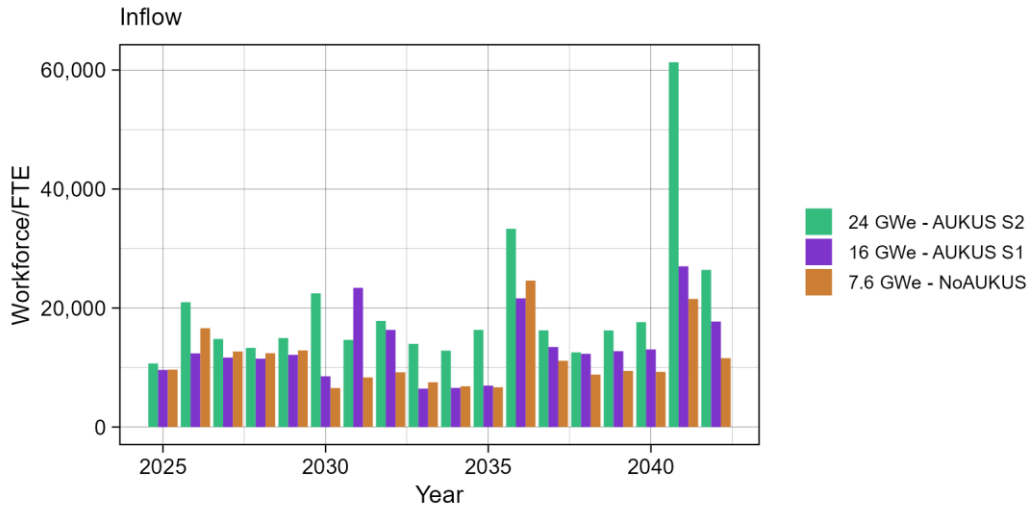

Figure 2

Figure 2 shows the corresponding inflow[1] (attrition rate[2] 7.5%) for each year required for the programme demands to be met in each of the three scenarios represented in Figure 1. Large increases are associated with step changes in the Defence demand profile.

Scenario 2 - 16 GWe (Civil) / AUKUS S1 (Defence)

In the following charts the middle combination of 16 GWe Civil power generation and AUKUS S1 Defence scenario is used.

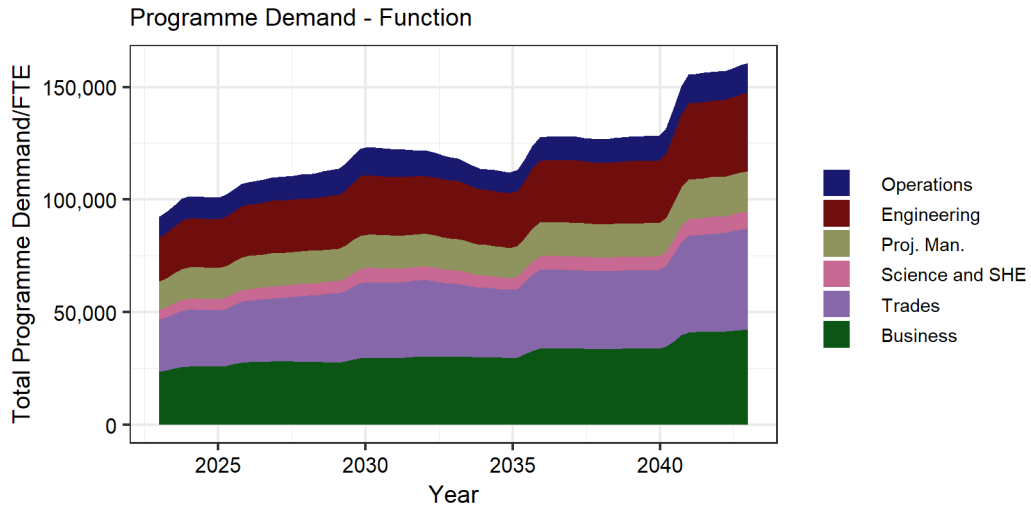

Figure 3

[1] Inflow is the number in each year required to raise the current workforce to the level of programme demand after attrition is applied, and assuming that each preceding year's inflow is realised. If the current workforce – attrition + inflow up to that point exceeds programme demand, the inflow in that year is set to zero. The calculation is applied at the level of role level within low level resource code at a particular site – i.e., the most granular level of the data.

[2] The attrition rate is the fraction (as a percentage) of the workforce leaving posts each year. It is not clear from leaver data whether individuals have left the UK nuclear industry or simply moved to another part. Data for the civil sector shows that around one fifth of recruitments are from within the UK nuclear industry.

In figure 3, the demand profile is shown split by six functions. The corresponding required annual inflow (attrition rate 7.5%) is represented below in Figure 4.

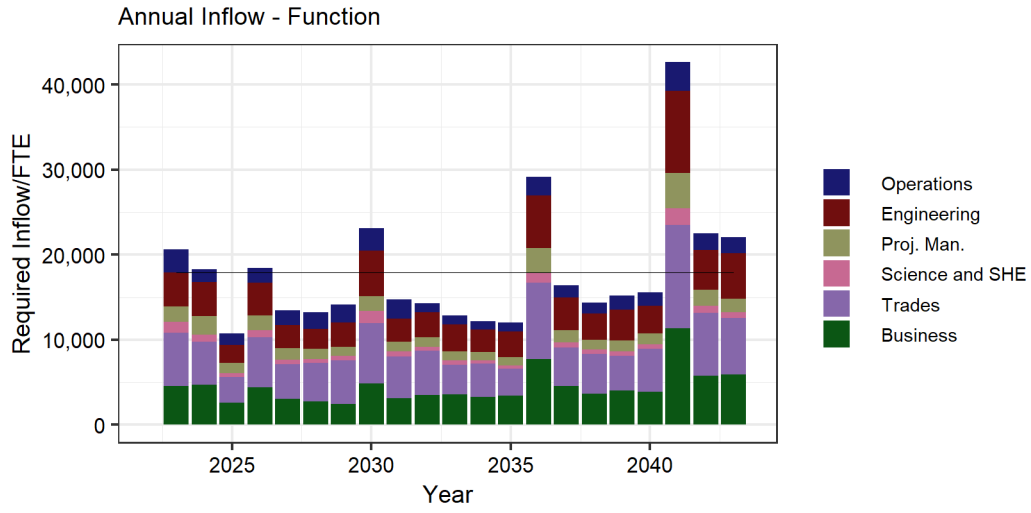

Figure 4

The average inflow is forecast to be 17,900 over the period 2023 to 2043, and 16,500 in the period to 2030. The number of new workers required depends on both expansion demand and the rate of attrition (Figure 5). A variation in the rate of ±3 percentage points results in a change in the annual inflow requirement of ±16% for the period to 2030, and ±20% for the period to 2043 (Table 1).

Period	4.5% Attrition	7.5% Attrition	10.5% Attrition
2023 - 2030	13,800 p.a.	16,500 p.a.	19,300 p.a.
2023 - 2043	14,300 p.a.	17,900 p.a.	21,500 p.a.

Table 1

Expansion and replacement Demand

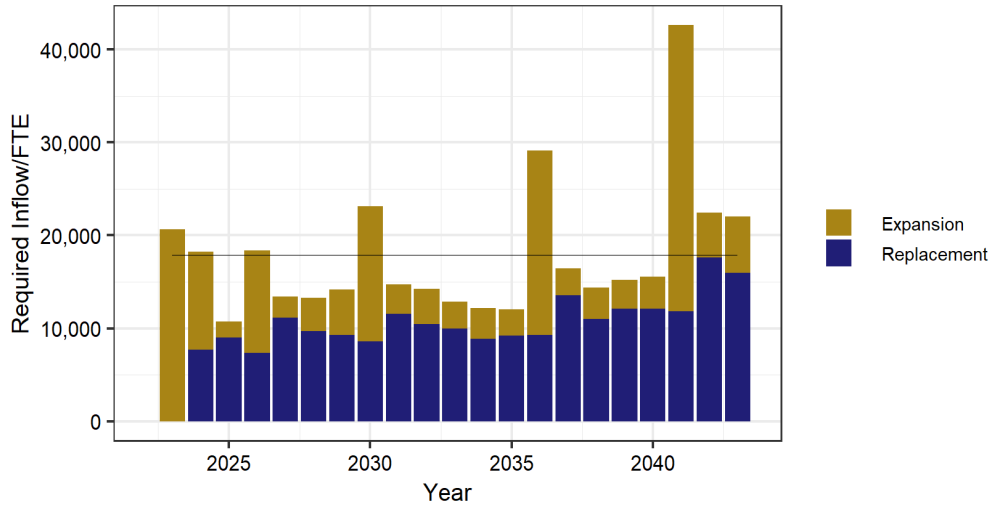

Figure 5

Inflow is formed from two components; 1) expansion due to increases in the programme demand, and 2) replacement, the workforce required to offset attrition alone (Figure 5).

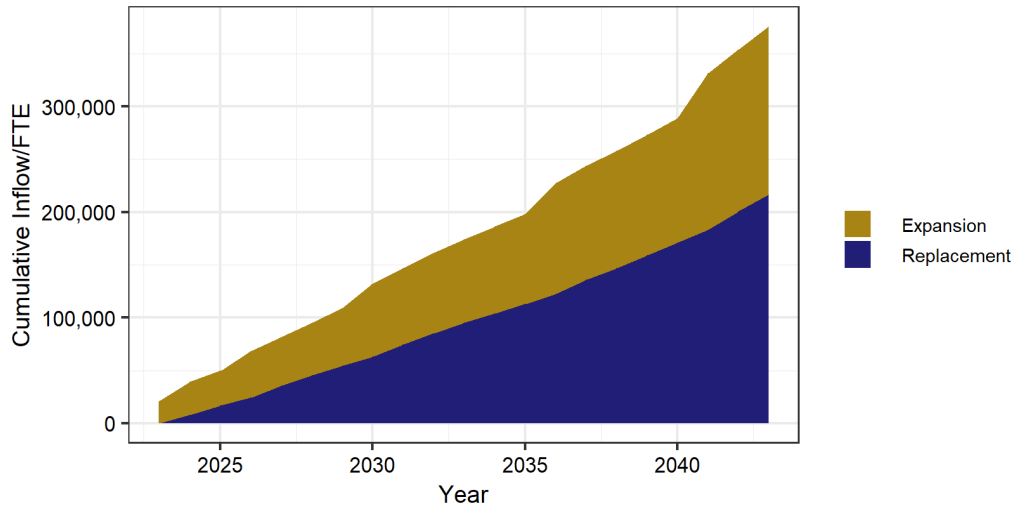

Figure 6

Cumulative inflow (Figure 6) reaches 111,000 by 2030, and 355,000 by 2043. Clearly, the long-term recruitment requirements can be limited by improving retention.

Civil and Defence

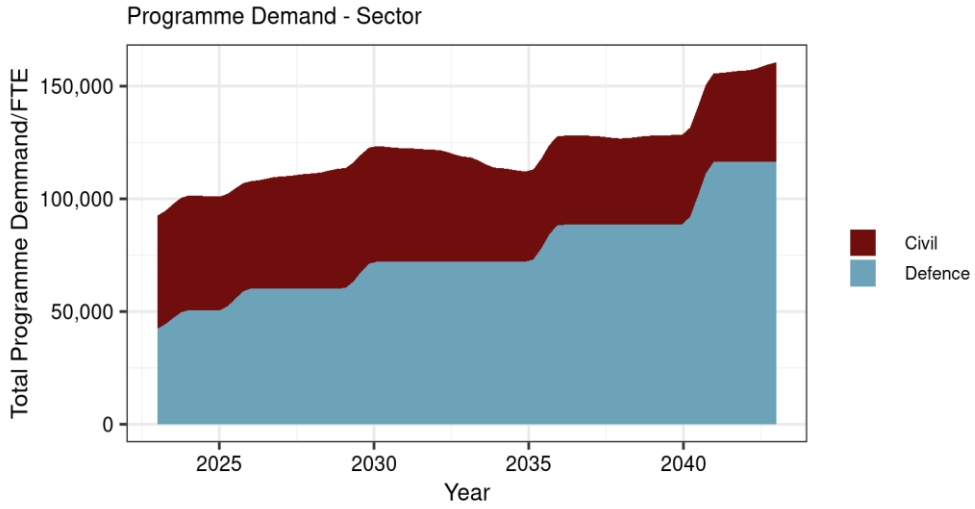

Figure 7

There is a significant difference in the relative contributions of the Civil and Defence subsectors (Figure 7). Evenly split in 2023 (Civil forms 54% of the total), the Defence sector is forecast to grow rapidly, while Civil decreases slightly in the period to 2043, where it constitutes 27% of the total.

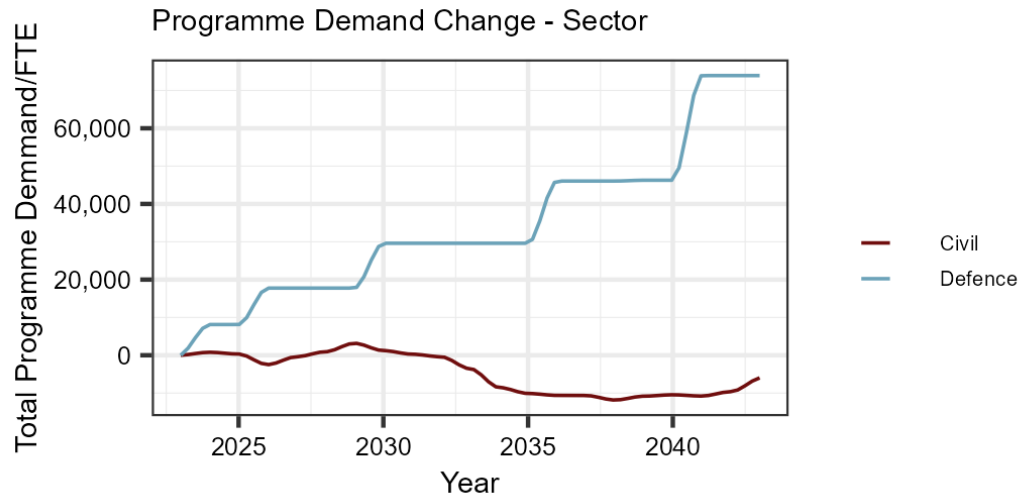

Figure 8

Figure 8 shows the change in total programme demand for the two sectors relative to their levels in 2023. By 2030, Civil demand remains essentially unchanged as a decrease in decommissioning offsets an increase in new build construction.

Civil Subsectors

Civil subsector can further be divided into other operational activities and nuclear new build (NNB). In Figure 9 the balance between the dominant but decreasing decommissioning activity, and the expansion of new build, is evident.

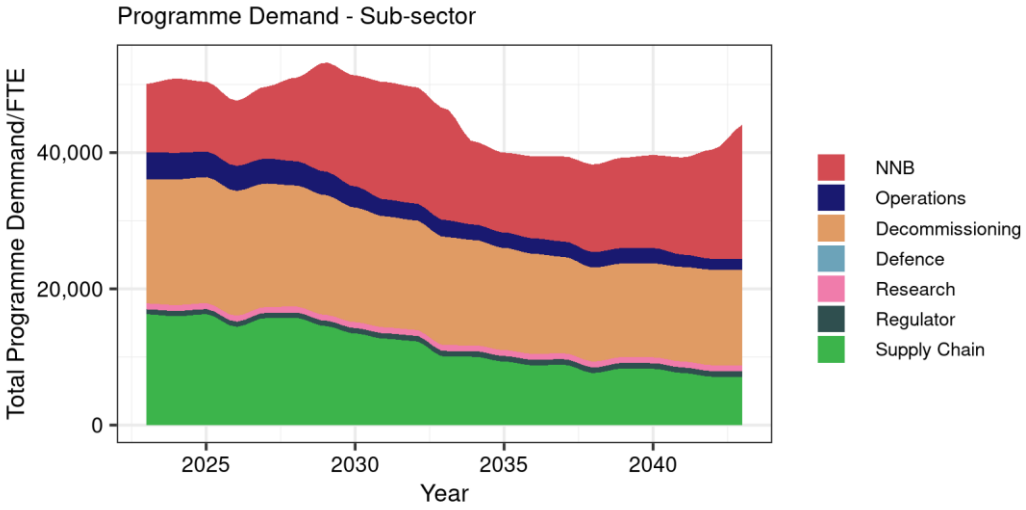

Figure 9

The supply chain component has been modelled from the decommissioning spend profile and is subject to change. Nevertheless, a decrease over time is expected as decommissioning projects are completed.

Regions

Workforce demand in different regions will depend on final decisions for the location of new Civil power generation projects. For the purposes of this summary, in addition to the ongoing construction of Hinkley Point C in the Southwest, and the assumption of Sizewell C in the East

region, further small modular reactor plant and gigawatt-scale projects have been located in the Northwest and Southeast.

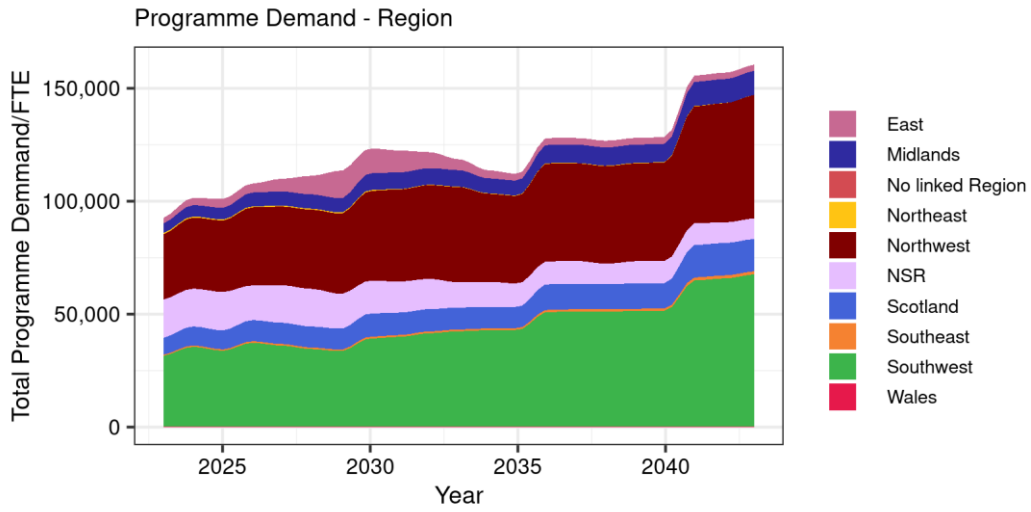

Figure 10

Figure 10 is a layer chart by region for both Civil and Defence. The southwest shows a considerable increase over the period, while the historically large workforce in the northwest remains comparatively constant. Demand in the East rises and falls as Sizewell C is constructed and then moves to operations.

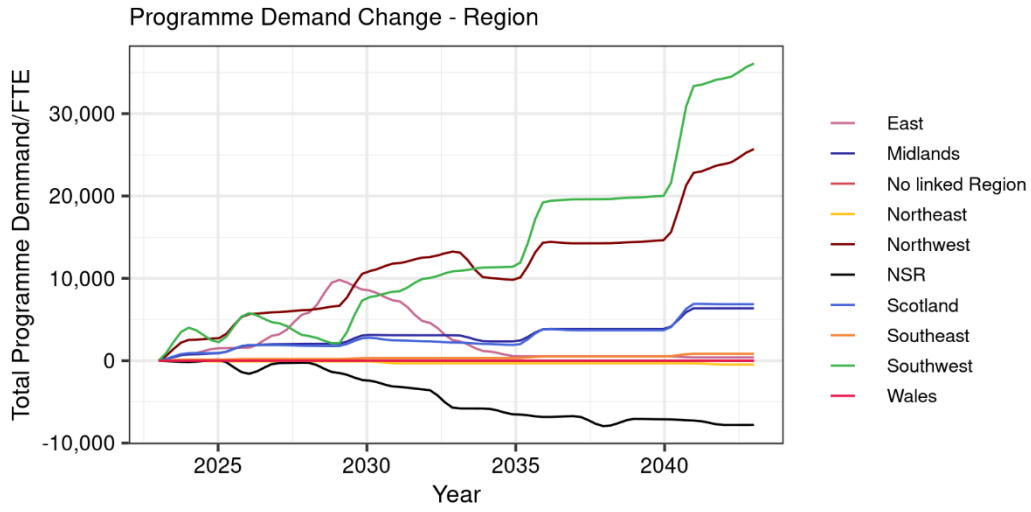

Figure 11

Figure 11 shows the change in regional demand over time. The negative going black line (NSR – no specific region) represents the geographically dispersed decommissioning supply-chain.

Current Workforce

The UK nuclear workforce as of 2023 stood at 83,095 including a modelled component for the Civil supply chain.

Level

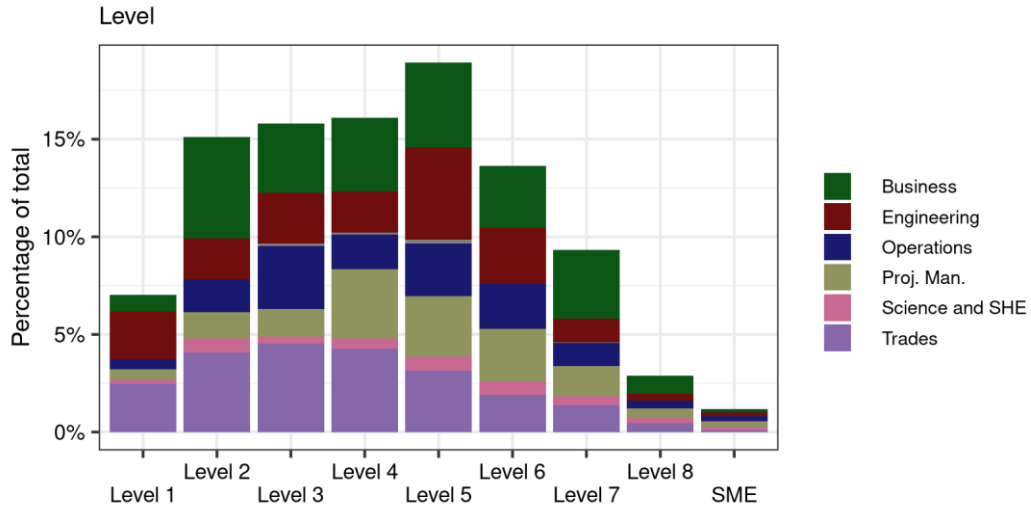

Figure 12

It includes nearly 1,000 workers identified as subject matter experts in the Civil sector alone (Figure 12). Significantly more than half of the workforce are at level 4 or above.

STEM (Science Technology Engineering and Mathematics) by Level

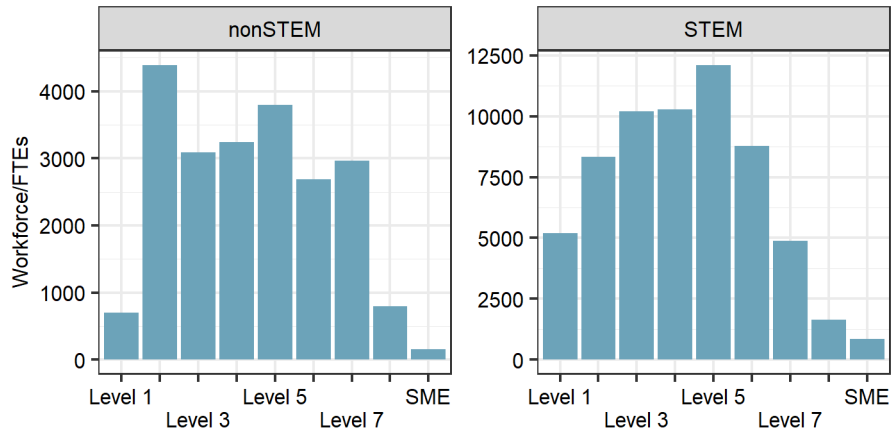

Figure 13

The profiles for non-STEM and STEM roles differ with more of the higher-level roles in the latter category.

Age

The workforce age profile has a bimodal form with peaks in younger and older age groups and a mid-age (and presumably mid-career) dip. Further analysis shows that the younger age group peak is driven by the Defence sector, and the older one by the Civil sector.

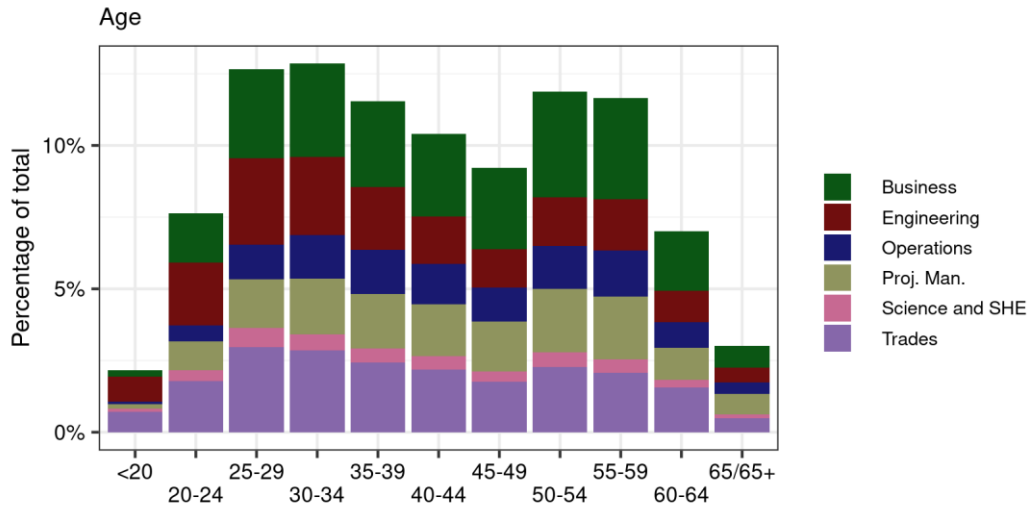

Figure 14

Ten percent of the workforce is aged 60 or above, which applies approximately equally across Civil and Defence.

Age STEM

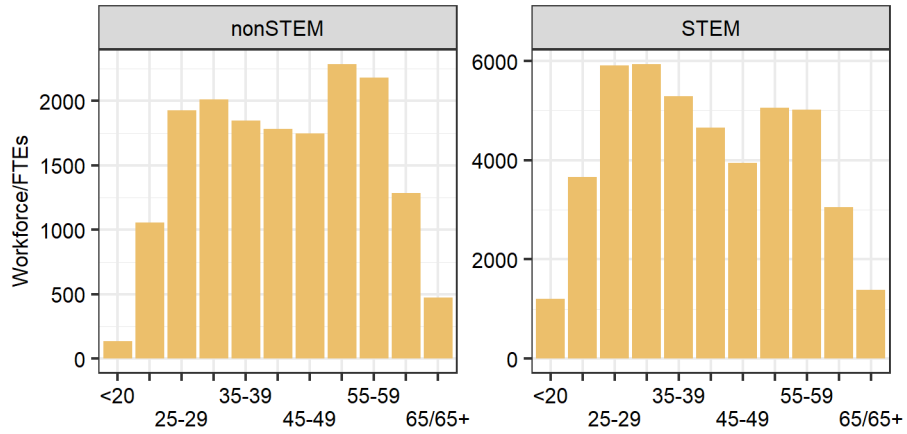

Figure 15

Again, non-STEM and STEM profiles differ, with STEM roles having proportionally more younger workers.

Recruitment

Civil sector employers reported 2,507 recruited full time equivalents, including 485 apprentices, 176 graduates and 1,846 staff ('experienced hires'). Around one fifth of those recruited were from within the UK nuclear sector.

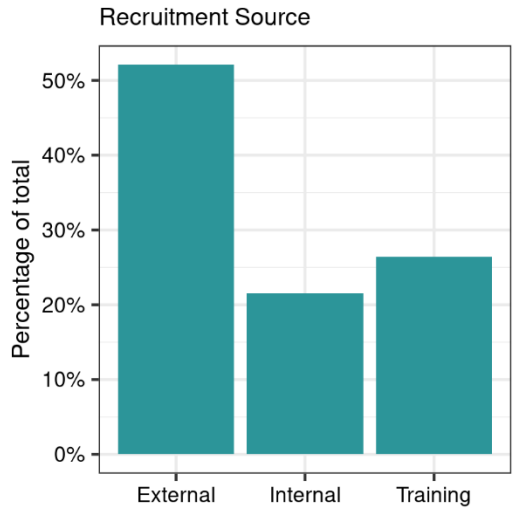

Figure 16

Recruitment took place at all levels but most notably at level 2, 3 and 6. The gender balance in the recruited workforce, which is important in the future development of diverse workforce, is discussed later in this paper.

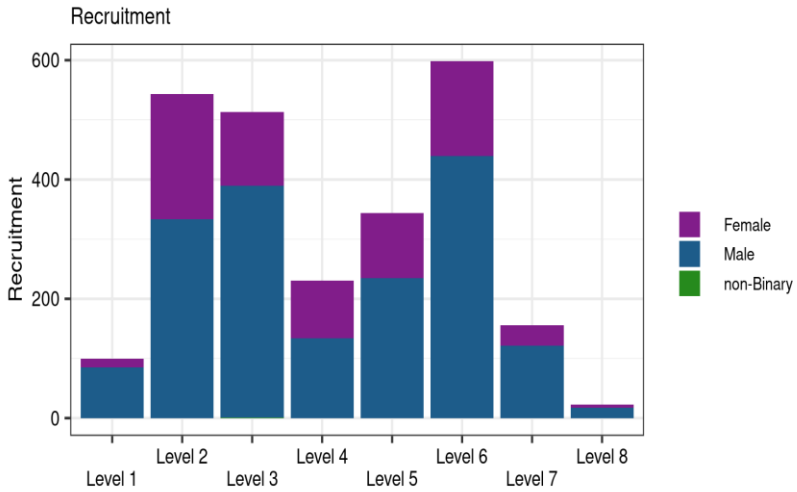

Figure 17

Training

Employers reported 1,183 trainees in post, including those starting in 2022/23, predominantly at levels 3, 5 and 6. A list of the degrees, standards and frameworks that make up this population is given at the end of this report.

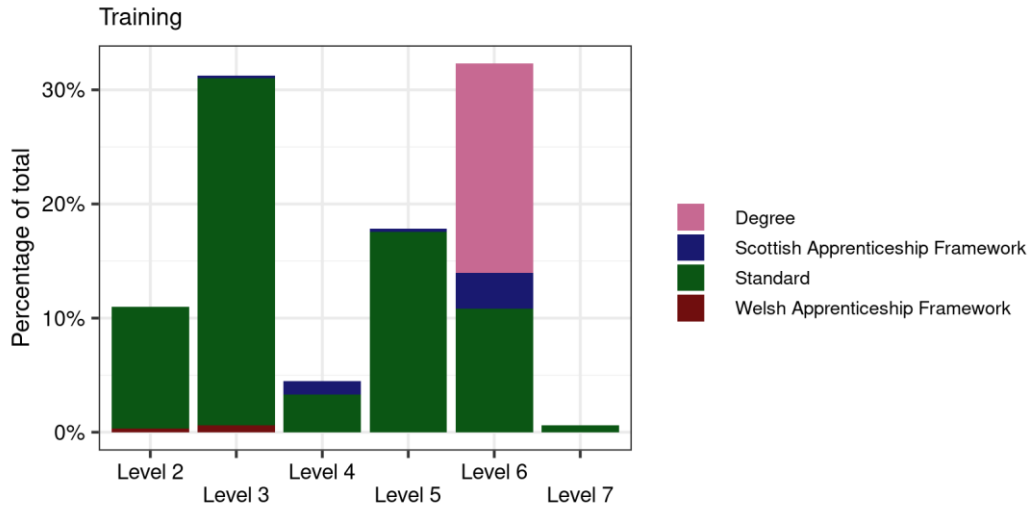

Figure 18

Equality Diversity and Inclusion

Ethnicity, disability, and sexuality data was requested for the first time in 2023. It is hoped that in future more comprehensive information can be collected. However, this still provides a useful starting point from which to develop comprehensive equality, diversity and inclusion statistics.

While information about protected characteristics is important, employees are not obliged to declare their status. Increasing the declaration rate will be an important target for EDI action. Here we report the statistics for the first time.

Not all Civil sector employers provided EDI data, and no EDI data was provided by the Defence sector.

Gender

Women currently form 21.4% of the nuclear workforce (26.4% in Civil, 17.8% in Defence). In STEM areas the figure falls to 17.6% across the sector (20% in Civil, 15.8% in Defence). In non-STEM areas 31.8% of the workforce is female (45.3% in Civil and 23% in Defence)

In enhancing inclusion, it is important to look across the industry and take care not to simply increase representation non-technical areas.

Representation varies with level (Figure 19), being highest in levels 3 to 6.

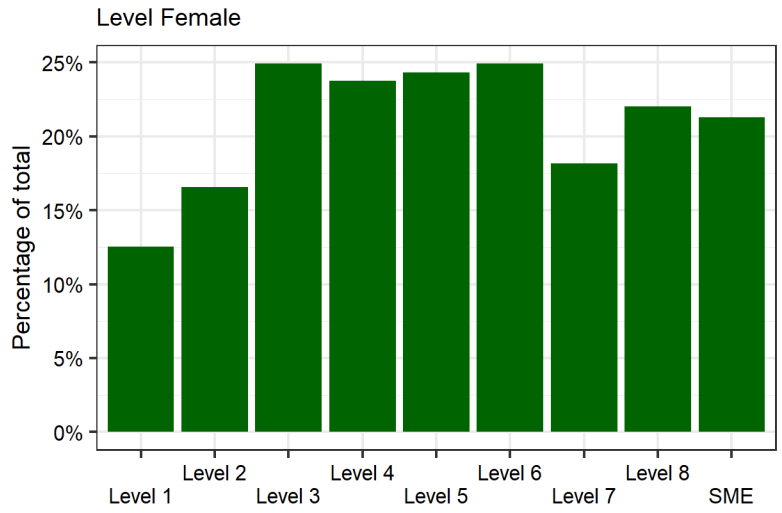

Figure 19

Women are represented at a comparatively constant level at all ages below 54 (Figure 20), after which the ratio of women declines, presumably reflecting poorer diversity in the past feeding through as the workforce ages. This pattern is broadly the case in both the Civil and Defence sectors.

As older workers retire, we can expect that the balance will improve towards 22-23%, all other things being equal.

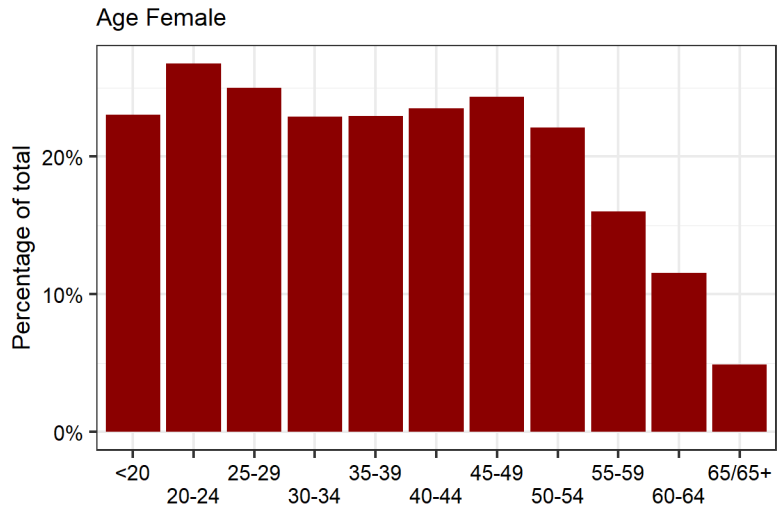

Figure 20

Balanced gender recruitment is critical to improving gender diversity. While the rate at which improvement can be achieved depends on staff turnover and potential expansion of the total workforce, the long-term profile will be no better than that seen in recruitment.

In the current data set, recruitment data were only available for the Civil sector, where women formed 30% of new staff (Figure 21).

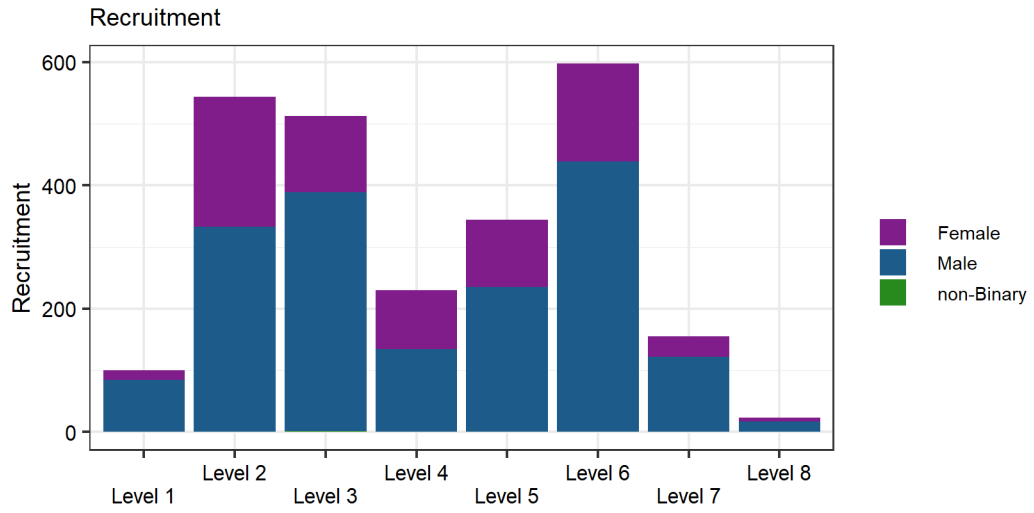

Figure 21

While the gender balance in recruitment determines the balance finally achieved in the workforce, attrition and expansion determine the rate of progress.

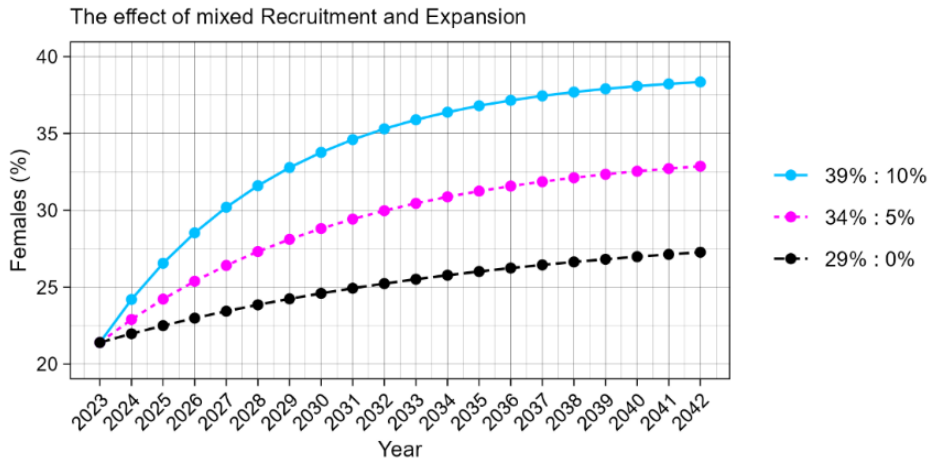

Figure 22

Using a simple model (https://cogent.shinyapps.io/genderforecast/) Figure 22 shows the combined effect of improving recruitment balance and expanding the total workforce at a fixed attrition rate of 7.5% p.a. Naturally this principle applies to any population characteristic, not just gender.

Ethnicity

For ethnicity, of those organisations providing data, declaration rates ranged from 60.4% to 92.4%

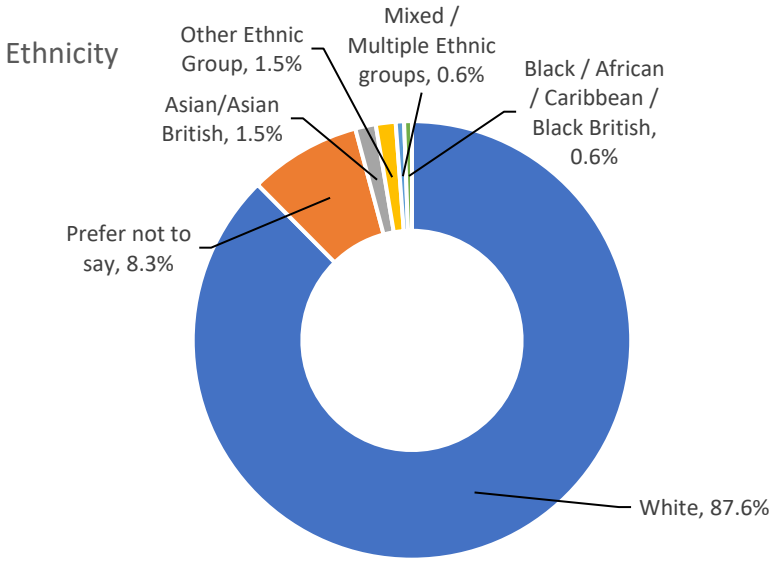

Figure 23

Disability

For disability, of those organisations providing data, declaration rates ranged from 59.2% to 97.5%.

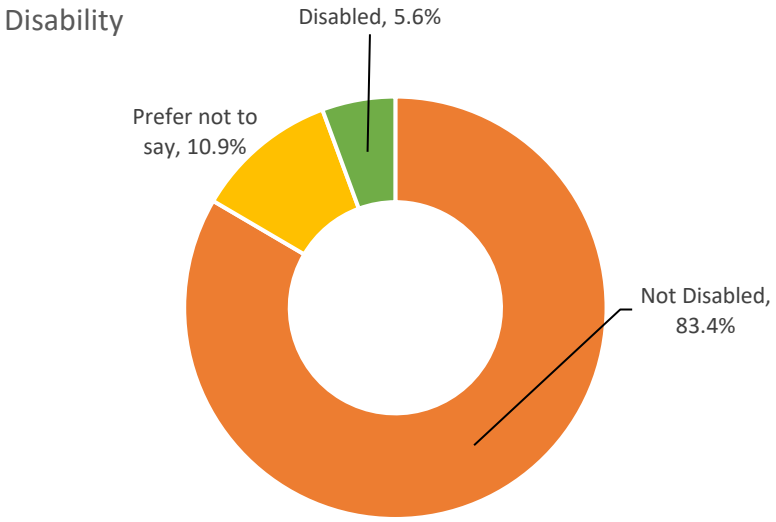

Figure 24

Sexuality

For sexuality, of those organisations providing data, declaration rates ranged from 29.4% to 92.7%.

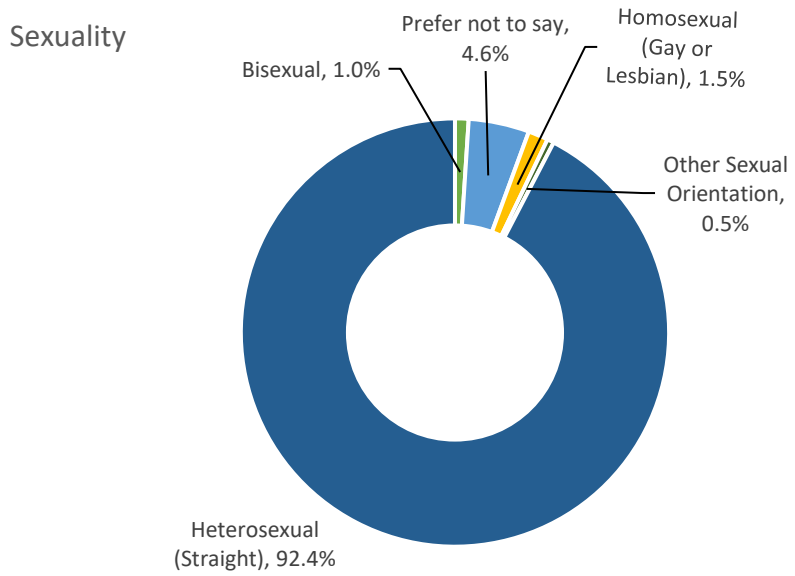

Figure 25

These first reports will be used by the EDI group as basis for improving reporting and setting realistic goals for broad EDI interventions.

Summary

As noted at the beginning the purpose of this report is to summarise the overarching workforce statistics that guide intervention development. More granular analysis will be carried out in response to specific data requests, recognising that the data going into the model imposes the final constraint.

- The sector workforce is set to rise in all three scenarios over the period to 2043, to:
  - 123,000 in scenario 1
  - 152,000 in scenario 2
  - 180,000 in scenario 3
- The middle scenario implies and required inflow into the industry of ~18,000 FTEs p.a. +/- 20% over the next 20 years
- The current work force is estimated at 83,095 across Civil and Defence
- 21.4% of the workforce is female
- 30% of the recruited workforce is female
- Crucially in STEM roles only 17.6% of the workforce is female
- 20% of civil recruitment is internal to the UK nuclear industry
- 10% of the workforce is 60 years old or older
- 45% of the workforce is at level 5 or above

Appendix

Training Courses, Apprenticeship Standards & Frameworks

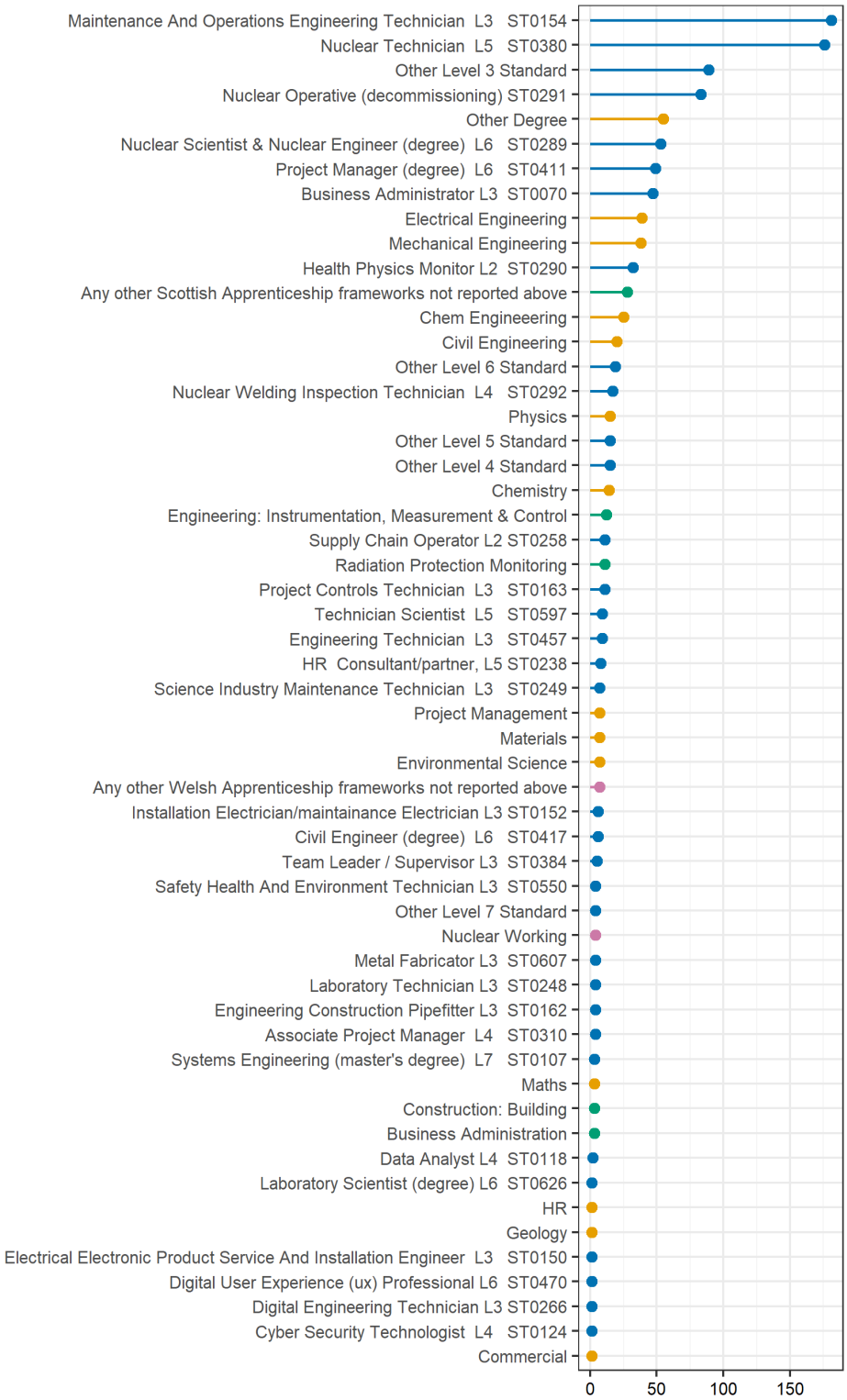

Figure 26

NSSG DELIVERED BY Cogent Skills

NUCLEAR TOGETHER

nssgmembers@cogentskills.com
www.nssguk.com
in Nuclear Skills Strategy Group